

Method and System for Appending Information to Graphical Files Stored in Specific Graphical File Formats

Field of the Invention

5 This invention relates to a method and system for appending information to a graphical image file in order to simplify the transmission, storage and distribution of certain information related to the image, and in particular to a method and system for appending information related to the graphical contents of a presentation slide to the end of the presentation slide file which can be stored in a file repository in a graphical file
10 format.

Background of the Invention

15 The World Wide Web, also referred to as the Internet, is a global computing environment in which all types information that is accessible from the Internet can be accessed in a consistent and simple way by using a standard set of naming and accessing conventions. Internet users can access computing sites all over the world from one location. A user can connect from his/her machine to thousands of Web servers simply by "clicking" on an image or by entering a specific address. Users can connect to many
20 different types of systems and not be aware of the system differences. Users can also access many different types of information such as text, images, audio, video and computational services. The user can perform all of these tasks using a single web-browser that can access this information. The ability to access information via the Internet is the result of hotspots (hyperlinks) that connect this seemingly infinite body of
25 information together. A hotspot is text or an image in a web site that can be accessed in order to have some action performed. During this process of accessing a hotspot, the user typically moves a pointing device such as a mouse over certain areas referred to as hotspots, then clicks the mouse to signal the initialization of the desired action.

30 In a computing environment, there are many graphical displays that appear on a user's machine. There are countless types of displays in any computing environment and include typical displays such as web pages and presentation slides. These displays also

contain information related to the nature of the particular display. The pieces of information on a display can be referred to as objects and can include text, charts, graphs and pictorial_images. Each display contains one or more of these objects. Each display also contains information about the objects contained on the display. This information includes information about any hotspot (hyperlink) objects contained on the display. This additional information is created by software during the creation of the display and is stored such that the information is transparent to the user or viewer of the display.

In many cases, the displays may be part of a larger set of displays. This situation is often seen with presentation slides. Slide presentations can contain multiple slides that are presented in a predetermined sequence. In these cases, it is sometimes necessary to transport the entire set of slides or to store the entire set of slides. During the transportation or storage of graphical displays it may be necessary or desired, to convert the displays to a compressed form in order to save storage space or to facilitate faster transport.

One standard for compression of still images is referred to as the JPEG standard. The Joint Photographic Experts Group (JPEG) has promulgated a standard for still image compression, which employs a Discrete Cosine Transform-based algorithm. The JPEG standard is described in a number of publications. Figure 1 describes the basic JPEG image encoding process. The JPEG method divides up the image into 8.times.8 pixel blocks **20**, and then calculates the discrete cosine transform (DCT) of each block **21**. The discrete cosine transform (DCT) helps separate the image into parts (or spectral sub-bands) of differing importance (with respect to the image's visual quality). The DCT is similar to the discrete Fourier transform: it transforms a signal or image from the spatial domain to the frequency domain. A quantizer rounds off the DCT coefficients according to the quantization matrix **22**. This step produces the "lossy" nature of JPEG, but allows for large compression ratios. JPEG compression techniques convert these coefficients to a binary data stream. In this encoding process **23**, JPEG's compression technique uses a variable length code on these coefficients, and then writes the compressed data stream **24** to an output file. For decompression, JPEG recovers the quantized DCT coefficients from the compressed data stream, takes the inverse transforms and displays the image.

Figure 2 illustrates a more detailed description of the JPEG encoding process. As shown, in the JPEG compression method implementing sequential encoding, the original image is divided into blocks of pixels, each block typically containing 8.times.8 or 16.times.16 original image samples **25**. Each 8.times.8 block of pixels is input to a DCT-encoder element **26** having a forward discrete cosine transform processor **27** that performs a Discrete Cosine Transform (DCT) on each pixel block. This transformation produces a representation of the input block as DCT coefficients corresponding to frequencies and amplitudes, rather than corresponding directly to color information. These coefficients are then quantized, or rounded off, by a quantizer element **28** in accordance with a quantization table **29**, and DC coding is performed that employs a difference algorithm over all quantized blocks in the image, in a selected scan order. This difference algorithm subtracts a "DC" or zero frequency term corresponding to the mean pixel value of a block, from the DC term of the preceding block. The difference coefficients are then scanned in a different order, such as a zigzag order, and the non-zero coefficients (i.e., blocks in which a difference from the preceding block occurred) are coded to indicate the number of preceding zero coefficients (i.e., the number of pixel blocks in which no change occurred) and also the value of the non-zero difference. An additional compression step known as entropy encoding is performed by encoder element **30** to achieve a more compact coding of the quantized DCT elements. Entropy encoding schemes specified by the JPEG standard include Huffman coding and arithmetic coding, with the optional implementation of entropy encoding tables **31**. The output **32** of the DCT encoder **26** is a data stream of compressed image data.

It should be understood that the key feature of JPEG compression is that an image is first segmented into disjoint 8.times.8 pixel blocks, each of which is replaced by its 2D DCT. In such a representation, the high frequencies tend to have very small coefficients enabling JPEG quantization to drive most of these coefficients to zero. This enables fewer bits to be stored after encoding.

Decompression is performed by reversing the compression process, and thereby producing the displayable image. As shown in Figure 3, this typically involves inputting the compressed image data **33** into a DCT decoder **34** including an entropy decoder block **35** for decoding the compressed image data stream, e.g., in accordance with a Huffman

decoding technique. At the output of the entropy decoder **35** the same data structure that the encoder **26** had at the end of the DCT transform is created. Then, a dequantization block **36** for dequantizing the image samples, and an inverse discrete cosine transform processor **37** for performing an inverse discrete cosine transform taking the decoded 64
5 DCT coefficients and reconstructing the original image.

As is known, the usefulness of decompression algorithms is determined by the number and the speed of mathematical computations performed to obtain the identifiable decompressed image. Typically, in image searching applications, it is required that each image is fully decompressed before the target image is located, which is a costly
10 proposition as many computations are required to achieve full decompression.

One image application that incorporates decompression for storage purposes is slide presentations. For example, a user can assume that a server stores a repository of 1,000,000 PowerPoint slides previously exported from PowerPoint into the JPEG graphical images format. In addition, for those slides, assume there is already a function
15 that bookmarks these slides and then automatically brings them down to a user PC and brings them into the PowerPoint program. At this point, the user needs to know of any Hotspots that were in the original slide before decompression that may not included in the slides brought to the user. This information could have been lost during the compression and decompression process. As previously mentioned, Hotspots are areas on an image
20 that link the image to executable instructions for specific operations. For example, the icons on a desktop would be Hotspots. Without knowledge of the layout of an original slide, a user may not know that some Hotspot or other information from a slide may have been lost during the compression and transfer procedures.

The current state of the art implementation of hotspot hyperlinks comprised of
25 (usually underscored) text strings is quite simple, the implementation of hotspots made up of pixel areas on an image is a bit more complex as a tool is required for the definition of the hotspot areas on the image. There remains a need for a method and system to track hotspot information on an image and include the hotspot information inside the actual image file to make it a complete navigation vehicle.

Summary of the Invention

It is an objective of the present invention to provide a method and system to distribute hotspot (hyperlink) information for a graphical image file as a part of the actual graphical image file.

It is a second objective of the present invention to provide a method and system to append information to a graphical image stored in an image file format such as a JPEG file using a JPEG format.

It is a third objective of the present invention to provide a method and system for appending graphical information to the end of a file stored in a file extension format.

It is a fourth objective of the present invention to provide a method and system to store graphical information about the contents of a graphical display file such as a presentation file that has been compressed and stored in a graphical image file format.

It is a fifth objective of the present invention is to provide a method and system to locate information about the graphical contents of a presentation slide stored in an image file format.

The present invention provides a method and system to append information to an image file containing a stored graphical image. The appended information relates to the contents of the graphical image. This information can include the physical coordinates of a hotspot on the image. One example of an image file format is a JPEG format. Using the JPEG format as an example, in the process of the present invention, there is the creation of an initial JPEG file containing a stored image. The stored image could be any graphical file. During the creation of the graphical file through software modules (such as a PowerPoint file or Freelance Graphics file), the user can insert images, other objects or text onto the file. Some of the objects (referred to as "Hotspots") can contain hyperlinks to other files or other system resources. The graphical software stores information related to every object on the graphical file.

During the process of converting a graphical image file to a JPEG file, the present invention takes the information concerning 'Hotspots' on the graphical file and generates an appendix to the created JPEG file containing this 'Hotspots' information. In this process, the method of the present invention first reads the original length of the JPEG file. The present invention then attaches the appendix containing the 'Hotspots'

information to the JPEG file. In this way the length of the JPEG file is modified to show the addition of the attached information.

The present invention also provides a method and system to decode the information in the extended image file. During the decoding of the extended image file, this method first reads the length of the appended file. The next step is to subtract the number of "n" bytes to find the length of the original image file. Once the knowledge of original image file is obtained, it is possible to get down to the start of the information that had been appended to the original file. The method then decodes the remaining appended extension information.

The present invention enables a user to secure vital information related to a graphical image during the conversion of the image into an image file format. The information contained in the appendix can be from any object type on a presentation slide generated with tools such as Microsoft PowerPoint or Lotus Freelance Graphics, or it can be an image area for example in pixel coordinates defined with an external tool.

Applications of this invention are not limited to the World Wide Web. The invention may be just as useful for any computer application programs with a need to allow a pointing device to point at areas on images and hereby present further information related to the image.

This invention is based on the idea of storing that further information inside the actual image or of storing hyperlinks to further information inside the actual image. If Web browsers such as Microsoft Internet Explorer or Netscape Navigator were enhanced to become capable of executing hotspot information previously stored inside an image file, the distribution of hotspot information for a graphical image would be dramatically simplified.

A special way of displaying further information about an image or a portion of an image is the use of popup images when the mouse is over certain areas of the image. These popup images may again be encoded using the method of this invention, so when the mouse is over certain areas of the popup image new images may popup. In this way large hierarchical cascading menus can be produced and stored inside one single image file. The subject of popup images or popup text for hotspots is one of the areas where the lack of compatibility between different web browsers make up a significant challenge and

significant extra cost to development projects. Further, the HTML and JavaScript code necessary to display large hierarchical cascading menus in a WebBrowser is voluminous and complex, while the method of this invention needs no transmission of code, only data.

- 5 The use of the present invention requires decoding capabilities at the receiving computer, for example, a Web Browser Plugin if the native browser does not (yet) have the ability to do the decoding of Hotspots. The present invention also can be used in a special purpose computer application program environment that has been developed including the capability to interpret the Hotspot information appended to image files.

Description of the Drawings

Figure 1 is an overview of the process for converting a graphical image to a JPEG file format.

5 Figure 2 is an expanded view of the process for compressing an image into the JPEG file format.

Figure 3 is an expanded view of the process for decompressing an image that has been compressed into a JPEG file format.

10 Figure 4 depicts data processing equipment a system that can be utilized to implement the present invention.

Figure 5 is a diagram of the architecture of the software implemented in the operation of the method of the present invention.

Figure 6 is a flow diagram of the general process for creating and appending an extension to a JPEG file.

15 Figure 7 is a view of a standard information record used to store information about the compressed contents of an image in an image file.

Figure 8 is an expanded view of an information record having multiple fields and pointers containing appended information from a file that is stored in a compressed JPEG format.

20 Figure 9 is an illustration of a record layout for a "Hotspot" or other entity on a graphical image.

Figure 10 is an expanded sample illustration of a record layout for a "Hotspot" or other entity on a graphical image.

25 Figure 11 is an illustration of a record layout for a Popup image entity for a graphical image.

Figure 12 is a flow diagram of a process to append information to a graphical image file such as a JPEG file.

Figure 13 is a flow diagram of a process to read and decode information appended to a graphical image file such as a JPEG file.

Detailed Description of the Invention

With reference now to Figure 4, there is depicted a pictorial representation of data processing system **40** which may be used in implementation of the present invention. As may be seen, data processing system **40** includes processor **41** that preferably includes a graphics processor, memory device and central processor (not shown). Coupled to processor **41** is video display **42** which may be implemented utilizing either a color or monochromatic monitor, in a manner well known in the art. Also coupled to processor **41** is keyboard **43**. Keyboard **43** preferably comprises a standard computer keyboard, which is coupled to the processor by means of cable **44**. Also coupled to processor **41** is a graphical pointing device, such as mouse **45**. Mouse **45** is coupled to processor **41**, in a manner well known in the art, via cable **46**. As is shown, mouse **45** may include left button **47**, and right button **48**, each of which may be depressed, or "clicked", to provide command and control signals to data processing system **40**. While the disclosed embodiment of the present invention utilizes a mouse, those skilled in the art will appreciate that any graphical pointing device such as a light pen or touch sensitive screen may be utilized to implement the method and apparatus of the present invention. Upon reference to the foregoing, those skilled in the art will appreciate that data processing system **40** may be implemented utilizing a personal computer.

The description of the present invention will be with reference to the particular graphical file format known as "JPEG". However, the techniques of this invention can be implemented with other graphical file formats as well. Figure 5 illustrates the architecture of the software implemented in the operation of the method of the present invention. The software system architecture as illustrated creates a standard image and an extension to the image that defines 'hotspots' on the image. As shown, the software can include presentation tools **50** such as Microsoft PowerPoint® or Lotus Freelance Graphics® software modules. These presentation tools **50** have the ability to create a graphical image and to define 'hotspots' on the image. These tools can also export the graphical image file **51** and hotspot definition information **52** such as coordinates of the image. The export software **53** transfers the standard image file from the presentation

tools to an encoding module. The conversion of the image to a standard image file such as a JPEG file can occur within the presentation tool software and prior to transferring the file.

An alternative architecture comprises graphics tools **54**. These tools are capable of creating graphical images. However, these tools do not define hotspot information on the created image. The 'save as' function corresponds to the export function in the presentation tools. Module **55** is a tool that defines hotspots on an image. In the diagram, the Hotspot definition tool reads the standard image file and a user manually defines hotspots on the image. At this point, there is a record containing standard image file **51** information and a record containing hotspot definition file **52** information.

The encoding program **56** combines the standard image file and the hotspot definition files. In the present invention, this combination occurs by creating the extension from the hotspot file and appending that extension to the standard image file **51**. The appending procedure results in the extended file image **57**. The next set of software modules **58** decodes an extended image file. This software could be located in another location on a computing network. As a result, the decoding program could receive extended image files over a global computing network such as the internet. The decoding software could be plugin program contained in a WebBrowser. This decoder program would have the ability to read and interpret the standard image file information and hotspot information from one file. The current decoding procedure requires that the image file information and hotspot information be in separate files in order for the WebBrowser to read the information. Since the encoded information would be in one file, it would be necessary for a WebBrowser to have software that could read the information from a single file. This plugin module would decode the extended image file and divide the file into the original image and hotspot information. Software module **59** would display and navigate the original image as desired by the user. As an alternative, the decoding software could also be a special purpose computer programs **60** and **61** can decode and display the information in the original graphical image.

Figure 6 illustrates the general steps in the preferred implementation of the method to create an appendix to a JPEG file. The initial step in this process is the creation of a graphical image in step **62**. This image can be a PowerPoint® or Lotus

Freelance type presentation slide or an image created with any graphics tool. The slide image may contain several objects such as text and images. Objects may have hyperlinks (hotspots), popup images, or popup text. The next step **63** is to create a JPEG file. As previously stated, this JPEG file could be any other graphical image file such as GIF format. There are many standard graphical formats that are known web browsers and graphic tools. Step **64** defines an area on the image as a 'Hotspot'. This step **64** can be performed using the image creation tool or an external tool. In graphical creation software such as PowerPoint, the user can define a 'hotspot' area on the image during the creation of the image. External software modules that can perform this task include tools without image editing capabilities but with capabilities for defining areas on an image e.g. in terms of pixel coordinates and with capabilities of storing hyperlink information for each area then becoming hotspots. After the defining of the 'hotspot', step **65** inserts hyperlink information for the 'hotspot' into the graphical image description. This information would contain instructions on things such as the size of the 'hotspot', the position of the 'hotspot', a target file or URL to go to when a user clicks the 'hotspot'. This insertion of information is done through conventional methods. The next step **66** is to determine whether there are more hotspots on the image. If there are additional hotspots, the process would return to and repeat step **64** for the additional hotspot. Following this insertion of hyperlink information, step **67** generates an appendix to the JPEG file created in step **63** using the defined 'hotspot' information. This appendix will contain information about a specific 'hotspot' contained on the original graphical image file.

Figure 7 illustrates the configuration of information that describes the objects contained in an original standard JPEG file. The information is stored in the form of a record. As shown, the record has four fields. The Header field **70** contains general introductory information that identifies this record as a JPEG file. The Directory field **71**, the Image Data field **72**, and the Indirect Data field **73** contain internal information for the JPEG file. The detailed description of these fields is outside the scope of this invention.

Figure 8 illustrates the configuration of information in an appended JPEG file of the present invention. Field **80** is the entire original JPEG record described in Figure 7.

Field **81** is the start of information field for the appended information. This field indicates that the information to follow is appended to the JPEG file. Fields **82** and **83** contain information about various 'hotspots' in the record. The number of substantive fields in an appended extension can vary depending on the content of an original graphical image file. The end of information field **84** signifies the end of the appended information. The length of original JPEG file is stored in field **85**.

It is essential for a later decoding process that a standard JPEG file without any hotspot information appended to it can be differentiated from a JPEG that has undergone the encoding process of Fig. 8, unless all JPEGs for a specific computer application environment have undergone the encoding process even if they had no hotspots on them. In that case all JPEGs would have at least field **80, 81, 84, 85**.

Figure 9 illustrates the type of information contained in the 'hotspot' field **82**. In the 'hotspot' record, there are parameter entries, type and size entries for each parameter and values for each parameter. In this record there is a LENGTH parameter with a size entry of S,8 which represents 8 bytes. The 'S' represents the fact that this parameter is a string. This entry indicates the length of the remainder of the 'hotspot' information. The "values" entry shown as '00000xxx' indicates these 8 bytes for the length of the information. The '8' represents the length of the string. The next parameter is the TYPE of information in the record. This parameter is indicated by the S,2 notation. Again, the 'S' represents the fact that this parameter is a string. The '2' represents the length of the string. The value of this parameter is indicated as '01'. The next four parameters X1, Y1, X2, and Y2 represent position coordinates for the 'hotspot'. These parameters have values of size four and indicated by the notation S,4. The parameter 'URL LENGTH' is the length of any linked URL address. The parameter is indicated by the type S,4. The last shown parameter is the actual URL. This parameter has an S notation. It should be noted that there is no standard notation and that the notation can vary from one graphical file image to another graphical file image.

The concern of differentiating a standard JPEG file from a JPEG file with extended hotspot information relates to the statistical question: Could a standard JPEG file by coincidence have a consistent hotspot definition structure at the end of the file? It is however possible with 100 % certainty to differentiate standard JPEG files from JPEG

TUESDAY, 5/4/03 5:50

files with extended hotspot information. A way of doing that with 100 % certainty requires the decoding program to know the internal format of a standard JPEG file, say field **80**, which is made up of fields **70**, **71**, **72** and **73**. In that way the decoding application would know the entire size of **80**. But this method is more sophisticated than desirable. For the sake of keeping the decoding program simple and allowing the invention to work in general with other graphical file formats than JPEG, more or less redundancy could be added to achieve a detection accuracy very close to 100 %. Already the encoding scheme of Fig 9 is most unlikely to hit by random. The decoding program may execute a number of validation rules, e.g. that all characters are within certain ranges in the ASCII character set, that LENGTH does not reach beyond the end of file, that TYPE matches a predefined set of types, that $X2 > X1$, that $Y2 > Y1$, that the hotspot definition scheme is followed by another hotspot definition scheme or field. But if even more certainty is required, redundancy can easily be added for example a field could be encoded with more or less sophisticated checksums for the extended portion of the file.

Figure 10 illustrates a completed 'hotspot' record example. As shown, the LENGTH parameter has a size of 8 bytes and a value of '00000064', which is the total length in bytes of the hotspot record. The TYPE parameter has a size of S,2 which indicates 2 bytes and has a value of '01'. Each position coordinate X1, Y1, X2, and Y2 has a size of 4 bytes and has values of '0264', '0512', '0606' and '0042' respectively. The URL LENGTH parameter has a size notation of S,4 and a value of '0042' which is the length of the URL string. The record has a URL address of '7652cedc868ef8ef6c12568bd0036a0f5a274.html' as indicated in the values field.

Figure 11 illustrates an example of a popup image record. Popup image records are not shown in Figure 8. But a popup image record could optionally be inserted after any hotspot definition record in Figure 8. This popup image can pop up on the display when the mouse for a system is over the hotspot on the graphical image. This popup image file is usually another original graphics file. Similar to the 'hotspot' field, the popup image has parameters, size and type and value fields. In this record there is a LENGTH parameter with a size entry of S,8 which represents 8 bytes. The "values" entry shown as '00000xxx' indicates these 8 bytes for the length of the information. The next parameter is the TYPE of information in the record. This parameter is indicated by

the S,2 notation. The value of this parameter is indicated as '02'. The '02' notation indicates that this record is a popup image instead of a 'hotspot' as indicated by the '01' notation. The FILENAME LENGTH is the next field. This field has a type and size indicated by the notation S,4. This field is similar to the URL LENGTH field in Figure 10 and will contain in the values parameter a number indicating the length of the filename. The FILENAME field has a type and size notation of 'S'. This parameter is comparable to the URL parameter. This value field will contain the original filename of the popup image file from before it was appended into the extended JPEG file. This filename is not required for this invention, but the field is available for file management purposes. The last popup image parameter is FILE DATA parameter. This parameter has a type designation of B. This notation indicates that the data is binary. The length of the binary data can be deducted from the LENGTH field subtracted by the length of the other fields. The popup image may again be encoded using the method of this invention, so when the mouse is over certain areas of the popup image new images may popup. Using this principle in a recursive way, large hierarchical cascading menus can be produced and stored inside one single image file. Optionally fields could be added to indicate whether the popup image should popup relative to the hotspot coordinates or relative to the actual mouse coordinates. In both cases another parameter could indicate a desired displacement offset to these coordinates.

Figure 12 illustrates a flow diagram of the steps involved in appending a record such as a 'hotspot' to a JPEG file. The initial step **90** in this process is to read the length of the original JPEG file. The length comprises the total length of all of the fields in a JPEG record such as the one illustrated in Figure 7. Step **91** appends the information for all 'hotspots' defined for a graphical image to the original JPEG file. Step **92** appends the length of the original JPEG file to the end of the newly appended JPEG file. This appending process is in the form of adding an additional field to the extended JPEG file as field **85** shown in Figure 8. The final step **93** in the appending process is to store this newly appended record.

Figure 13 illustrates the steps involved in decoding and reading the appended 'hotspot' information from the JPEG file. This method in Figure 13 is the interpretation software for this method. In this method, step **94** reads the length of the total extended

JPEG file. The next step **95** is to determine whether there has been any information appended to an original JPEG file. Step **95** is meant to cause a break during decoding in **96, 97, 98** if the record structure turns out to be inconsistent. In that case it can be concluded that the JPEG is an original standard JPEG with nothing appended to it. Step

5 **96** subtracts n bytes from the end of file to read the length of original JPEG field **85** to determine the length of the original JPEG file. The next step **97** is to use that information to get to the start of the information in the JPEG extension. Step **98** reads all 'hotspot' information that is appended to the JPEG file.

It is important to note that this invention has been described in the context of a

10 specific graphical file format (JPEG) and with regard to presentation slides. The techniques of this invention can be implemented any graphical file format. It is also important to note that while the present invention has been described in the context of a fully functioning data processing system, those skilled in the art will appreciate that the processes of the present invention are capable of being distributed in the form of

15 instructions in a computer readable medium and a variety of other forms, regardless of the particular type of medium used to carry out the distribution. Examples of computer readable media include media such as EPROM, ROM, tape, paper, floppy disc, hard disk drive, RAM, and CD-ROMs and transmission-type of media, such as digital and analog communications links.

20 Having thus described the invention, what we claims as new and desire to secure by Letters Patent is set forth in the following claims.